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There are other features of the specimens that will be described and illustrated in a larger paper on Malaysian basket work in preparation. I wish now to call attention to a new variety of textile and to inquire concerning the existence of other examples.

O. T. MASON

U. S. NATIONAL MUSEUM,  
January 30, 1908

#### NOTE ON THE "LAFAYETTE BEDS" OF LOUISIANA

SOME very interesting facts are being brought to light in southern Louisiana by the large number of oil-wells put down since the date of the famous Lucas gusher in 1901.

In undisturbed beds near the coast we find the Quaternary molluscan fauna extending down to about 2,000 feet. The drill samples show sands, clays and gravels, the latter of typical Lafayette type to at least 1,500 feet. Oyster reefs are encountered more or less frequently, showing a sinking of several hundred feet in comparatively late times. In the Texas Galveston well, and in the regions where underlying beds have been brought up near the surface, as in the Jennings oil field, the first pre-Quaternary fauna is Miocene in appearance, not Pliocene. It has been customary to regard the Lafayette as approximately Pliocene. But our well records seem to indicate that the seaward continuation of the gravels in the central portion of Louisiana as well as in those states to the east and west are rather Quaternary than Pliocene, and that the whole embayment region, perhaps, was above sea-level in Pliocene times and was being eroded instead of being below sea level and receiving hundreds of feet of coarse littoral sediment. It would seem then, that Hilgard's views as to the contemporaneousness and interrelationship of the coarse "Orange sands" in the south and the ice sheets in the north may prove correct in spite of the fact that certain "Lafayette" gravels are said to lie beneath glacial till farther north.

G. D. HARRIS

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#### SPECIAL ARTICLES

##### THE PENETRATING RADIATION

IN the present article three distinct methods will be given to show that the penetrating

radiation which produces part of the ionization in closed vessels is not due to  $\gamma$  rays from radium in the ground itself. It seems quite probable that the penetrating radiation must be due to radioactive products in the air and it is quite probable that the origin of these products is in the ground as Elster and Geitel's theory indicates.

The first method is based upon the radium content of the various rocks as analyzed by Strutt and Eve. The highest value for the radium content of sedimentary rocks was found to be  $2.92(10)^{-12}$  grams of radium per gram of rock. The mean value found by Strutt for sedimentary rocks was  $1.1(10)^{-12}$  grams and by Eve  $.8(10)^{-12}$  grams. The value of the radium content varies greatly with the locality, but for surface soils which are subjected to all the various kinds of weather changes the radium content is probably smaller than that found above. For instance, Strutt found a radium content for chalk at the bottom of a cliff to be  $.39(10)^{-12}$  grams and at the top of the same cliff  $.12(10)^{-12}$  grams.

$.9(10)^{-12}$  grams per gram of rock will probably be in general a maximum value for surface rocks. This quantity will be called  $Q$ .

Eve (*Phil. Mag.*, Sept., 1906) has determined  $K$ , the number of ions produced per c.c. by the  $\gamma$  rays in air from one gram of radium bromide supposed concentrated at a point and at a distance of 1 cm. The number of ions produced per c.c. at a point near the surface by a semi-spherical shell of ground of radius  $r$  and thickness  $dr$  is

$$\frac{2\pi r dr \delta K Q}{r \times .6} e^{-\lambda r},$$

where  $\delta$  is the density (about 2.7) and  $\lambda$  is the coefficient of absorption for the ground (say .09). The factor .6 comes in since  $K$  is given for radium bromide and  $Q$  for pure radium;  $K$  is  $3.1(10)^6$ . The total number of ions produced per c.c. per second by the ground would be

$$\int_0^\infty \frac{2\pi r dr \delta K Q dr}{.6r} e^{-\lambda r}.$$

This value comes out about .8 ion per c.c. per second as a probable maximum amount.

Cooke found that the penetrating radiation produced about 4.5 ions per c.c. per second and McClellan has recently found 9. We thus see that the radium content of the ground is too small to account for all of the ionization produced by the external penetrating radiation. Eve (*Phil. Mag.*, August, 1907) reaches a similar conclusion.

Taking  $\lambda$  for air to be .00004 and assuming Cooke's value for the ionization produced by the penetrating radiation, one can calculate the radium content of the air necessary to furnish a sufficient amount of  $\gamma$  radiation. Supposing these radioactive products to be contained by the lower strata of air—say for a height of 300 m.—one finds that this is equivalent to the radium content of some 60 centimeters depth of ground, taking  $Q$  equal to  $.9(10)^{-12}$ . This depth is rather large, but is not entirely impossible. The diurnal temperature wave penetrates to a depth of about one meter and barometric waves probably penetrate much deeper.

It has been found by Campbell, Wood, the writer and McKeon that the value of the external penetrating radiation which produces part of the ionization in closed vessels varies very considerably in amount, these variations often amounting to more than one or two hundred per cent. in the course of two or three days. If this penetrating radiation is due to the  $\gamma$  rays from the ground it should be practically constant. Moreover, Dike has found that the active deposit in the air also varies very greatly in amount. The writer has found in several instances that the penetrating radiation falls almost to zero value during a heavy rain or snow (SCIENCE, July 12, 1907). Now Wilson, Rutherford and Allen have shown that rain and snow carry down radioactive products. If this is true, then, according to our theory, the penetrating radiation would be considerably decreased. During a very heavy rain the decrease should be very noticeable, and might reach a very low value. If the external penetrating radiation is due to radium products in the air, then after a heavy rain the penetrating radiation should increase rapidly for one or two hours after the stopping of the rain, since the products

radium  $A$ ,  $B$  and  $C$  will reach equilibrium values in that length of time, and the  $\gamma$  rays come from radium  $C$  only. Results indicating a recovery of the penetrating radiation similar to this have been noted in one instance.

The writer has tried glass electroscopes with practically all metal parts covered with sulphur. Since glass and sulphur give off very little intrinsic radiation, the ionization should be produced chiefly by the external penetrating radiation. The results found so far are so irregular that they are as yet hard to interpret.

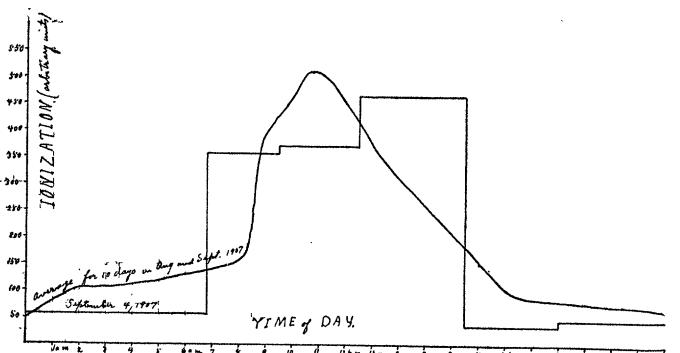
During the summer of 1907 some observations were made in the Cumberland valley (Trenton limestone similar to that analyzed by Eve) seven miles from Harrisburg, and one mile from any town. The electroscopes were lined on the inside with aluminium. Readings during the day were made every few hours. During the night, as the leak was very slow, few readings were made, so that readings were not frequent enough to show the double daily period. The curves do show the enormous increase of the ionization during the early hours of the day. During the night the ionization was very small. The electroscope was placed in a cistern in the ground and was thus surrounded on all sides by at least four feet of water. In this case the penetrating radiation was entirely cut off and it was found that there was no difference in the ionization found during the various parts of the day. Moreover, the amount was roughly the same as that observed during the night on the surface of the ground.

The conclusion is that during the early hours of the day the penetrating radiation was quite large, the walls of the electroscope being thick enough to absorb any  $\beta$ -like rays.

Curve 1 represents the values found September 4, 1907.

Curve 2 represents averages found for several days during August and September, 1907.

During the early hours of the day, according to Elster and Geitel's theory, the ground would become warmer and its emanating power would be greatly increased. Radioactive products would thus accumulate in the lower strata of the air, and as the coefficient



of absorption for air is very small, the penetrating radiation would be very considerably increased. The amount of ionization in the open air is in agreement with this view.

Curve 2 is very similar to the curves representing the hourly rate of change of temperature during the day.

The third method is the determination of the rate of leak below the ground. If the penetrating radiation is due to the  $\gamma$  radiation from radium in the ground, the ionization caused by it should be twice as much in a well or cave in the ground. During the summer the writer tested this by placing the electroscope in a cave. The rate of leak was found to be somewhat less than that occurring during the night on the surface, and was found to be about the same as the leak when the electroscope was surrounded with four feet of water in a cistern. Moreover, the rate of leak was the same during the day as during the night. Similar results have been found by Elster and Geitel.

The conclusion is that a large part of the ionization in closed vessels due to the external penetrating radiation is subject to large variations, and probably consists of  $\gamma$  rays from radioactive products in the air rather than in the ground. These products vary very much in quantity according to atmospheric conditions. A very convenient method of measuring these products is by measuring the amount of the ionization due to the penetrating radiation.

The writer wishes to express his sincere ap-

preciation of the constant spirit of interest shown by Professor Ames.

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#### MELTING-POINT CURVES OF BINARY MIXTURES OF THE THREE NITRANILINES

SOME interesting results have developed in the course of an investigation of the subject mentioned above. We prepared a series of mixtures of ortho- and metanitraniline, the difference in composition between each consecutive member being 2 per cent., and plotted the melting points of these mixtures against their composition. The curve produced was regular, it fell from  $71^\circ$ , the m. p. of the pure ortho compound, to  $54^\circ$ , the eutectic point, then rose steadily to  $114^\circ$ , the m. p. of pure metanitraniline. It is possible, therefore, to employ the curves to determine the composition of mixtures of the two isomers. For this purpose the melting point of the substance under examination is determined; this gives, in general, a temperature corresponding to a position on each limb of the curve and therefore to two possible mixtures. Another portion of the substance is now ground up with an approximately equal weight of either of the pure isomers—say the meta- and the m. p. of this mixture is determined. If it is lower than that of the first one the composition of the original material is represented by the point on the ortho-limb of the curve, whereas, if the second m. p. is higher than that of the first, the composition is read off from the